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Estrategia metodológica para la resolución de problemas algebraicos

Methodological strategy for solving algebraic problems

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RESUMEN: La investigación realizada aborda los antecedentes históricos de la habilidad resolver problemas, así como la sistematización de los referentes teóricos que sustentan el desarrollo de están habilidad. En el estudio diagnóstico del objeto de estudio se caracterizó la situación que presenta el campo de acción. El objetivo del trabajo es elaborar una estrategia metodológica para desarrollar habilidades en la resolución de problemas algebraicos. Mediante la aplicación de diferentes métodos y técnicas de investigación se logró comprobar la factibilidad de la propuesta, la cual mostró niveles superiores en el desarrollo de las habilidades algebraicas necesarias para la solución de problemas algebraicos.
Palabras clave: Habilidad resolver problemas; Problemas algebraicos; Estrategia metodológica

ABSTRACT: The realized investigation tackles the historic background of ability solving problems as well as the referent theoreticians' systematization that they hold the development of our ability. The situation that presents the range of activity was characterized in the diagnostic study of the object of study. Reaffirming the need to plan a strategy methodological to develop abilities in the problem solving algebraic. By means of the application of different methods and it got fact-finding your techniques to check the feasibility of the proposal, which showed superior levels in the development of the algebraic necessary abilities for the solution of algebraic problems.
Keywords: Ability solving problems; Algebraic problems; Strategy methodology

Introduction

One of the objectives of the teaching of Mathematics in the Cuban school is the resolution of problems related to practical life. In algebra there are some of the appropriate solution paths, specifically those related to the approach and solution of equations and systems of equations.

The teaching of algebra becomes complex because the transition from arithmetic to algebraic work is a complex learning process for students, since it requires a high level of abstraction. Bednarz and

Guzmán (2000, p. 36) talk about a process of transition from arithmetic to algebra through a process of important adjustments to a part of previously developed knowledge.

Man's ability to solve problems takes into account the assimilation of concepts. It is an indispensable point in the world, as it is considered an activity of great importance and characterizes one of the most intelligent behaviors of man.

This content is not only an activity to enable the student to face the problems of the school and outside it, but it is a way to reach high levels in the intellectual development and in the way of thinking of the students.

In this regard, the fourth objective of the general program of Mathematics states: Formulate and solve with the resources of Elementary Mathematics problems related to the political-economic and social development of the country and the world, as well as scientific-environmental phenomena that lead to responsible attitudes towards life.

There are many researchers who have delved into the subject such as Palarea (1998), Sánchez (2022), Pérez (2020), Cruz and Romero and Marrero (2020), but there are still difficulties in teachers such as, for example: inexperience in education due to years of work, type of professional training, which slow down the correct development of algebraic problem-solving skills, including:

- the actions and impulses that teachers indicate in problem solving do not lead students to find the way to a solution independently, as well as make them the protagonist of the process;
- problems are not seen as a process of search, of investigation but as a means of obtaining a correct answer;
- Insufficient knowledge of mathematical concepts and their applicability in problem solving.

In this referential context, this work focused on the development of skills in algebraic thinking, so it is proposed to design a methodological strategy that contributes to the development of the ability to solve algebraic problems in first-year students of the specialty of Mathematics teachers for the Basic Secondary School of the Pedagogical School “José Marcelino Maceo Grajales”.

Development

Problem solving, considered as an activity carried out by the student, is subject in its development to its orientation, execution and control. In this sense, Polya (1965) considers four stages that correspond to the three moments of the activity: understanding the problem and conceiving a plan (orientation towards the problem and work on the problem); execution of a plan (Execution of the solution); retrospective vision and perspective (Evaluation of the problem and the solution).

In problem solving, some trends can be found, among which are: The problemic teaching and the teaching of problem solving Campistrous and Celia (1996, p. 12), this article emphasizes the teaching of problem solving that has been widely disseminated through the texts that state and practice "strategies" to solve problems and then they pose problems in applying them. This approach is assumed, in addition to Polya's pioneering work.

Due to its feasibility in the process, in the development of this work we assume the definition of problem given by, Sarduy (1996, p. 12) taken from Parra (2021): "It is a certain situation in which there are links, relationships, qualities between objects that are not directly or immediately accessible to the person", where the presence of objects, relationships and properties of them and between them is explicitly pointed out; it even admits the existence of relationships that are not immediately accessible to the person, interpreted that he in turn assumes the need for transformations for purposes towards the solution.

Several authors have given their definitions of ability, starting from nature, of what constitutes our object of study, we assume in our work the definition of mathematical ability given by A.V. Petrovsky where it is expressed as "the mastery of a complex system of psychic and practical actions necessary for a rational regulation of activity with the help of the knowledge and habits that the person possesses" taken from Parra (2021).

Main theoretical conceptions underlying the methodological strategy

From a pedagogical profile, the authors of this research assume the criterion of Valle (2010, p.188), taken from Parra (2021) when he defines strategy as "a set of sequential and interrelated actions that, starting from an initial state (given by the diagnosis), allow the passage to an ideal state as a consequence of planning".

This definition offers the elements for from the diagnosis to the integration of all the components of the teaching-learning process, considering interrelated actions. The components of the system are: the mission, the objectives, the actions, the methods and procedures, the resources, those responsible for the actions and the time in which they must be carried out, the forms of implementation and the forms of evaluation.

Structure of the methodological strategy

The methodological strategy is structured as follows:

I. Foundation **Mission**. The context and location of the problem to be solved, ideas and starting points that underpin the strategy are established.

II. **General objective statement**

III. **Strategic planning.** Short and medium-term **goals or objectives** are defined that allow the transformation of the object from its real state to the desired state.

IV. **Staged planning of actions**, resources, means and methods that correspond to these objectives.

V. Instrumentation. Explain how it will be applied, under what conditions, for what time, managers, and participants.

VI. **Evaluation** Assessment of the achievements and inadequacies that have been overcome, approaching the desired state

Methodological proposal

The following proposal is descriptive, covering the methodological strategy which will allow the development of logical-mathematical reasoning at the educational level specified for pedagogical schools, specifically for the training of Mathematics teachers for Basic Secondary School.

They are structured as follows:

1. **Theme**: it is proposed according to the activity that is carried out.
2. **Objective**: it is formulated according to the established proposal taking into account the diagnosis made of the current situation and determination of the desired state.
3. **Activity:** activities related to algebraic work will be carried out such as solving equations, translating practical language situations common to algebraic and vice versa and problem solving whose solutions depend on the approach of equations.
4. **Resources:** the resources will be used according to the subject to be treated through the teaching-learning process.
5. **Evaluation**: this will take into account the assessment of the results obtained, identification of obstacles overdue and the feasibility of implementing the proposed activities and actions.

Recipients of proposal

The proposal will be aimed at teachers involved in the development of the teaching-learning process in students of the Mathematics specialty in the Pedagogical School so that its implementation allows the process to be revitalized and the correct development of the mathematical skills necessary for the resolution of algebraic problems is achieved.

Techniques to be used for the preparation of the proposal.

The following techniques and instruments will be used:

The questionnaire: Set of designed questions, which are of great interest in an investigation to be answered and obtain results that lead to a solution. (Methodological preparation of the subject and departmental meetings)

The bibliographic search will allow defining each of the concepts, looking for the best techniques and ways to develop the proposal.

This proposal will begin with a diagnosis that will allow the current state of the problem in question and the determination of the factors that affect the development of algebraic skills for the resolution of problems of this type, and from there draw the general and particular objectives for its implementation in a period of short, medium or long term as appropriate.

We have as a theoretical study the bibliographic research of several authors defining the concepts related to algebraic thinking and the teaching of algebra as a useful tool for solving problems of practical life, which leads us to the search for various types of strategies that contribute to the solution of the problems found.

For its application, it is necessary to take into account how the teaching of algebra proceeds according to the course of the Guideline "Working with variables" for the resolution of problems according to the objectives and demands of the Mathematics programs in each grade of the Basic Secondary School.

Implementation of the Methodological Strategy for solving algebraic problems.

Mission: The preparation of teachers of the Mathematics subject for the development of the pea aimed at solving algebraic problems in first-year students of the specialty of Mathematics teachers for the Basic Secondary School of the Pedagogical School "José Marcelino Maceo Grajales"

General objective: Prepare teachers of the subject Mathematics for the development of the pea aimed at solving algebraic problems.

Stage I: Diagnosis

Objective: To determine the main limitations and potentialities that teachers present in their preparation for the development of skills for solving algebraic problems for problem solving in first-year students of the Mathematics specialty at the José Marcelino Maceo Grajales Pedagogical School.

Action

Process of determining the individual difficulties of teachers in the process of teaching algebra for the resolution of algebraic problems in the first year, for which the information obtained will be

processed, the qualitative analysis of the results of the processing will be carried out and the main regularities will be determined.

Suggestions for this stage: It is aimed at the diagnosis of mathematics teachers who teach the first-year program, being of great value for whereas, it allows diagnosing the deficiencies and potentialities of these, in order to plan the theoretical, methodological and attitude elements necessary for the use of the methodological strategy that provides the correct development of algebraic skills.

Stage II. Teacher guidance.

Objective: Explain the essential ideas of the strategy and the elements that characterize the necessary theoretical knowledge about solving algebraic problems to achieve the conscious participation of teachers in the actions.

Action: Hold a methodological meeting where the strategy and its methodology are presented. Explanation of the importance of the actions proposed in the strategy. Motivation of teachers based on the importance and significance of the contents that will be studied.

Suggestions for this stage: These actions aim to achieve adequate motivation to contribute to achieving satisfactory results in the teaching-learning process of Mathematics and provide sufficient guidance so that teachers can execute them individually and collectively.

Stage III. Execution

Objective: To develop the basic methodological elements within the teaching-learning process of Mathematics for the development of algebraic problem-solving skills in first-year students.

Stage Actions:

Develop activities within the methodological work system of the subject with the aim of perfecting the development of the teaching-learning process of Mathematics for the development of problem-solving skills.

Action #1: Methodological Meeting

Topic: Current situation of the development of skills for solving algebraic problems and proposed solution.

Objective: To analyze the difficulties encountered in the diagnosis in terms of the treatment of solving algebraic problems.

Method: Exposure

Resources: Computer resources, programs, textbooks and methodological guidelines.

Responsible: Principal teacher of the subject.

Participants: Mathematics teachers.

Deadline: September-February.

Conclusions: The current state in relation to the problem is recognized, showing real willingness to cooperate in the implementation of the strategy and transform the current state.

Evaluation: The indicators that are evaluated are the following:

- Contributions made to achieve effectiveness in the work to use group work techniques, it can be a PNI (positive, negative, interesting).

Action #2: Methodological Workshop

Topic: The guideline "Working with Variables" in the development of skills for solving algebraic problems

Objective: To analyze the course of the guideline working with variables taking into account the organization of the content at the different levels of education and its adaptation to the demands of the Pedagogical School's curricula for the development of skills in solving algebraic problems

Means: Mathematics Program, Methodological Guidelines, Textbook, text "The course of guidelines in Mathematics programs and teaching planning", computer resources.

Responsible: Senior Lecturer, Head of Department.

Participants: Mathematics teachers.

Forms of evaluation: Oral questions.

Deadline: September - February.

Evaluation: The oral review of the activity is carried out, encouraging analysis and reflection among all members of the group.

Conclusions: The fundamental ideas worked on in the activity will be expressed and an evaluation of it will be carried out.

Action #3: Methodological workshop

Topic: Methods, techniques and skills for solving mathematical problems.

Objective: To analyze what are the theoretical-methodological pathways for the development of the ability to solve algebraic problems taking into account the General Heuristic Program (GHP).

Means: Text "Learning to solve arithmetic problems" by Campistrous and Celia Rizo; Textbooks; subject programs; methodological guidelines.

Responsible: Principal teacher of the subject.

Participants: Mathematics teachers.

Deadline: September - February

Conclusions: A summary of the fundamental ideas discussed in the workshop and their importance for the proper development of the teaching-learning process of Mathematics aimed at solving problems that lead to the approach of equations will be made.

Evaluation: The indicators that are evaluated are the following:

- Contributions made to achieve effectiveness at work.

Action #4 Instructional methodological class.

Topic: How to develop problem-solving skills?

Objective: To analyze the different techniques and skills necessary for solving algebraic problems and their usefulness in practical life.

Means: Textbooks, Programmers of the subject,

Methodological Orientations.

Managers: Main teacher of the subject.

Participants: Mathematics teachers, department head.

Deadline: First semester

Conclusions:

Conclusions will be reached from the analysis of the criteria issued during the debate and the importance of the topic for the development of the teaching-learning process of Mathematics.

Evaluation:

The indicators that are evaluated are the following:

- Contributions made to achieve effectiveness at work.

Action #5: Demonstration class

Objective: To demonstrate how to prepare and plan activities to treat algebraic skills to solve algebraic problems.

Responsible: Principal teacher of the subject. **Deadline**: First semester **Participants**: Mathematics teachers.

Conclusions:

Assess the functionality of the activity carried out.

Evaluation:

To carry out an evaluation, the following indicators will be taken into account:

- Contributions and contribution to the development of the proposed topic.

Action # 6: Open Class

Objective: To verify the validity of the methodological procedures that can be used by teachers to contribute to the development of algebraic skills for solving problems that lead to equations.

Means: Class plan, textbooks, subject program, educational software.

Responsible: A selected teacher

Deadline for completion: First semester

Conclusions

The open class as a way of collective reflection allows all teachers to observe one or more teachers, favoring the exchange on what has been achieved and what remains to be achieved in the work of developing skills for solving algebraic problems taking into account the different solution techniques and procedures to solve equations, also enhances self-evaluation from the process of self-reflection.

Evaluation: In this final action, the effectiveness of the methodological strategy can be evaluated.

Action #7: Final methodological workshop.

Subject: Evaluation of the methodological strategy**.**

Objective: To assess the impact of the strategy on teachers with a view to their preparation for the development of problem-solving skills that lead to the approach of a mathematical equation.

Media: Computer resources, Programs and methodological guidelines, Textbook.

Responsible. Main teacher of the subject

Participants: Mathematics teachers, main teacher of the subject, department head.

Evaluation: Oral.

Deadline: First semester

Conclusions:

The fundamental elements exposed during the realization of the different methodological actions will be analyzed and an assessment will be made about the usefulness of these, and their usefulness for the development of skills for the resolution of algebraic problems.

Stage IV: Strategic Monitoring and Evaluation Objective:

Monitor and evaluate the effectiveness of the designed strategy.

Actions:

Assessment of compliance with the objectives of the proposed strategy.

Methods and Techniques.

Interviews with students and teachers. Observation of classes and exchanges with teachers.

Means: Instruments developed for observation, diagnosis.

Date: After applying the strategy in its entirety.

Evaluation of the proposal by specialist criteria.

Ten specialists were intentionally selected based on pedagogical experience and knowledge about the research topic. First, a self-assessment was applied to know: scientific degree, research carried out in the field of mathematics teaching and their knowledge about the subject, and then the strategy evaluation sheet was applied.

Regarding applicability, 100% gave the maximum score. 100% gave the maximum score to the cientificity indicator. 30% (3 teachers) raises the need to train methodologically in terms of work with learning strategies for solving algebraic problems.

100% of specialists say that they consider the methodological strategy very appropriate at present and the scientific level responds to the needs of the current context in which the skills for solving algebraic problems are developed.

Contribution of the strategy to the solution of deficiencies in the development of skills for solving algebraic problems.

The specialists in their entirety affirm that the implementation of the planned actions makes it possible to totally increase the preparation of teachers, so that from the teaching-learning process they develop the algebraic skills to solve mathematical problems in students, a search attitude towards knowledge, enhancing developer learning, an approach to the practice and reality that students will have to face as future teachers.

On the other hand, when analyzing conceptions about learning before the proposal, it could be concluded that a reproductive conception predominates in 74% of the sample; only 36% express a tendency to active learning

Then 82.1% can describe the steps they take to solve a problem that leads to an equation, 76% recognized the steps that are easier or more difficult, 68% reported being able to remember the steps to take to solve an algebraic problem.

Level of applicability of the strategy.

A total of 9 specialists consider that there is no difficulty in applying the strategy which represents 90% of the total, they argue that the center has all the conditions for its implementation, it is

considered by the respondents as a novel way for the formation of professional skills, it is important to apply the proposal because it is of the utmost importance for our country to graduate teachers with a broad mastery of their profession so that they contribute efficiently to economic development. One specialist, which represents 10%, states that the demotivation towards solving mathematical problems and the little study habit of some students, can negatively influence with respect to the proposed objective in the research.

Conclusions

The grounding of the theoretical - methodological references on the research object allowed to demonstrate the need for the preparation of teachers for the treatment to the development of algebraic skills, for the resolution of problems that lead to the approach of equations. The implementation of the methodological strategy made it possible to perfect the teaching-learning process for the adequate development of skills to solve algebraic problems. The results obtained with the assessment of the feasibility of the methodological strategy allowed the verification of the validity of the proposal as a way to strengthen the development of skills for solving algebraic problems, which confirms the novelty of the proposal.

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